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Michaelowa, Katharina

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Returns to Education in Low Income Countries:

Evidence for Africa

Paper presented at the annual meeting of the Committee on Developing Countries
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Katharina Michaelowa¹
Hamburg Institute of International Economics

1. Introduction

Over the second half of the 20th century, and in particular during the 1960s and the 1970s, Africa experienced a massive growth of enrolment at all levels of education. On average for sub-Saharan Africa, gross enrolment rates at primary level doubled from 40% in 1960 to almost 80% in 1995. At the secondary level they increased eightfold, from 3.4% to 27% during the same period (World Bank 1999). The growth of education for females was even more impressive than for males, and led to a growth of female literacy rates which many other developing countries in South Asia, the Middle East and North Africa could not match (Sender 1999, pp. 92ff.).

Education affects the life of individuals, their participation in economic activities, and overall economic development in various ways. Since a person without basic literacy and numeracy skills is in a difficult situation to master everyday life, the lack of basic education has always been accepted as one of the major components of any multidimensional concept of poverty. Moreover, education is strongly linked to the notion of empowerment. This paper, however, will focus on the *economic* returns to education. Other effects will only be discussed where they interfere with economic effects.

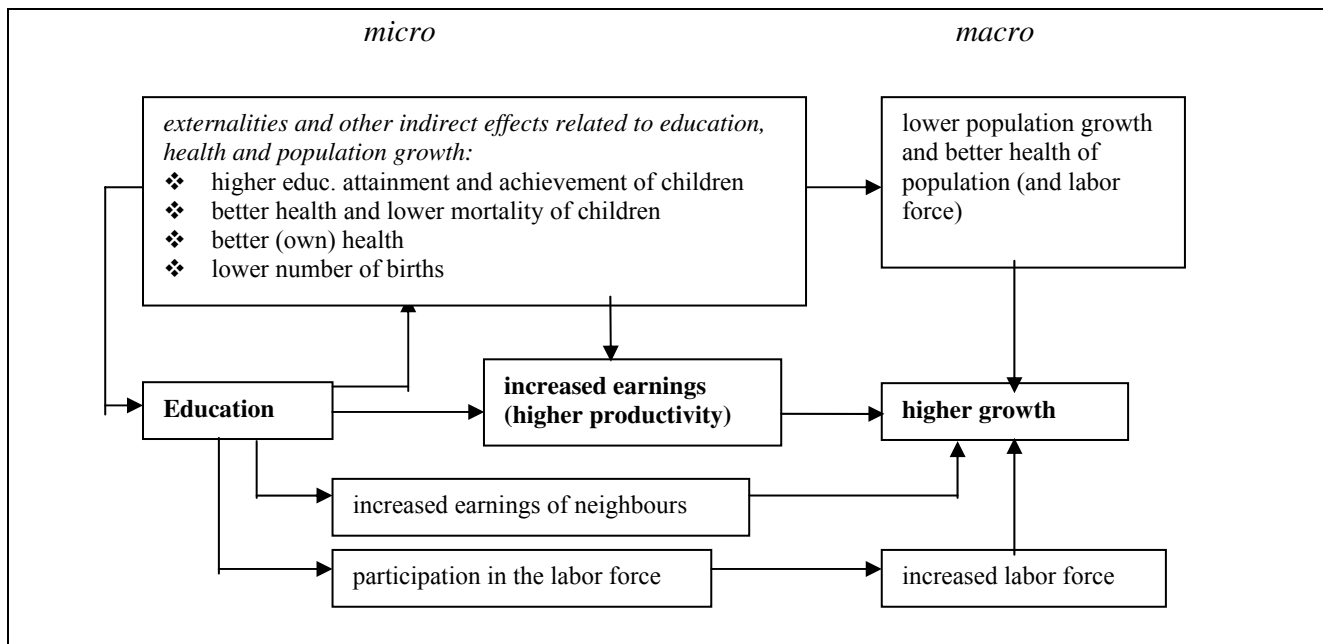
Human capital theory as well as endogenous growth theory suggests that there are substantial economic effects of education on the micro and the macro level respectively. Looking for an effective tool to foster economic progress in developing countries, the analysis of economic returns to education has been a much-researched field since the beginning of the 1960s. This paper attempts to review some of the available empirical evidence for Africa and to clarify the limitations of current research. Since literature on economic returns to education is abundant and uses multiple methods with a variety of results that are not always easy to reconcile, it seems worthwhile to provide a structured overview and discussion of different approaches. In this context, particular

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emphasis will be given to the link between micro and macro level analysis. Since the focus of this paper is on low income countries in Africa, arguments will be checked for their specific relevance for this group of countries.

Figure 1 provides an overview over expected effects concerning economic returns to education. This overview can be useful to guide through the following sections. Starting at the micro level, the direct link between education and individual earnings will be at the center of discussion. Moreover, indirect effects and externalities, as well as the impact of education on labor market participation will be taken into account. Finally, the consequences of microeconomic results on macroeconomic outcomes and the difficulties to reach convincing empirical results at that level will be discussed.

Figure 1: Economic returns to education



2. Evidence at the micro level

2.1. Direct private returns to education

The link between education and increased individual earnings is very well documented in the literature. The most commonly used approach is based on some variant of the Mincerian earnings function (Mincer 1974). Thereby the natural logarithm of wages (w) is regressed on years of schooling (S), a proxy of labor market experience (E), its square (E^2), and, depending on the author, a variety of control variables (X) (Temple 2000, pp. 9f.):

$$(1) \quad \ln(w) = \alpha + \beta_1 S + \beta_2 E + \beta_3 E^2 + \beta_4 X + \varepsilon$$

Assuming that the cost of additional schooling is equal to foregone wages the semi-logarithmic formulation allows to interpret the coefficient of the schooling variable as the private returns to education, i.e. the annual increase in income ($w_s - w_{s-1}$) divided by the annual cost of the investment (w_{s-1}) (Glewwe 1996, p. 269):

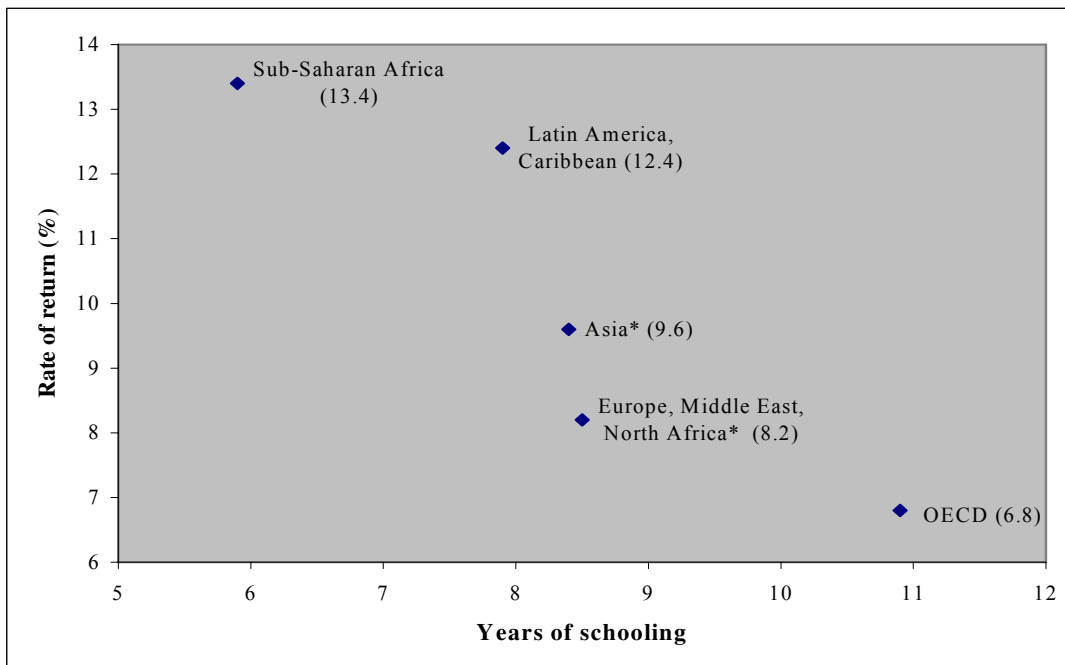
$$(2) \quad \frac{w_s - w_{s-1}}{w_{s-1}} = \frac{w_s}{w_{s-1}} - 1 = \frac{e^{a+\beta_1 S + \beta_2 E + \beta_3 E^2 + \beta_4 X + \varepsilon}}{e^{a+\beta_1 (S-1) + \beta_2 E + \beta_3 E^2 + \beta_4 X + \varepsilon}} - 1 = e^{\beta_1} - 1 \cong \beta_1$$

Psacharopoulos (1994) provides an overview over the results of the extensive literature in this field for over 70 countries, presenting in each case the latest study available until the early 1990s. While the disadvantage of this survey is that it does not cover more recent studies of the 1990s, the overriding advantage is that the studies are selected out of an even wider sample of hundreds of studies to this topic, on the basis of common and therefore comparable methodologies. With respect to studies using the basic Mincerian framework described above, his survey covers 62 countries. Results appear to be quite consistent across countries and across time in that there is a clearly positive effect of additional education. For the nine African countries covered, one additional year of schooling leads to private returns of between 8 and 20% (Psacharopoulos 1994, pp. 1342f.). Figure 2 shows how the average rate of return of sub-Saharan African countries compares with the average rates of other regions in the world. The simultaneous ordering of regions by returns to education and average years of schooling suggests a negative relationship between these two variables: The rate of return to education is particularly high when the supply of educated labor is rather scarce. Even though enrolment has greatly increased in sub-Saharan Africa over the last decades, the region has not yet been able to catch up in terms of average years of schooling. This could explain why the rate of return to education is markedly higher in this region than in any other region of the world.

At the same time, demand for educated labor obviously influences private returns to education as well. This effect is difficult to separate from the supply effect discussed above. In order to obtain an unambiguous estimate of the supply effect, Mwabu and Schultz (2000) select a specific situation where supply of education varies independently of demand. Their model case is South Africa during the apartheid system, where the government rationed the access to the education system for political reasons. The resulting relative scarcity of skilled black labor as compared to the relative

abundance of skilled white labor, independently of labor market demands, was clearly reflected in the considerably higher returns to an additional year of schooling for blacks than for whites.

Figure 2: Mincerian returns and average years of schooling



*Only non-OECD.

Source: Psacharopoulos (1994, pp. 1321 and 1331)

Another approach to distinguish demand and supply effects is to look for exogenous factors determining either of the two separately. Comparing East Asian and Latin American countries, for instance, Birdsall, Ross and Sabot (1995, pp. 182f.) argue that returns to education are positively related to growth in manufactured exports. The latter is interpreted as an indicator of an expansion of demand for skilled labor.

Observing trends in supply and demand of skilled labor in many African countries suggests that in recent years, both trends would jointly tend to reduce the high estimates for private returns to education found by Psacharopoulos in studies for earlier decades (Hussain, Moyo, Oshikoya 2000, p. 3). In the early years after independence, there was a strong demand for skilled labor to fill the posts left by the previously colonizing power, and to create the countries' own administrative and economic structure. Supply of labor with secondary attainment and above was extremely limited. With growth of enrolment, the supply of skilled labor rose considerably in the next decades while private sector demand did by far not evolve at the same pace. However, in many countries, the increasing supply of skilled labor was initially absorbed by the public sector. Gelb, Knight and

Sabot (1991, Table 1) show this by comparing the growth of wage employment in the public and the private sector. Between the mid-1960s and the early 1980s, public sector employment accounted for 67% of the rise in total wage employment in Kenya, 107% in Egypt, 190% in Tanzania and 418% in Zambia. During the 1980s, it became obvious that this employment policy was financially unsustainable in the long run. Forced by financial constraints and / or by the requirements of structural adjustment programs, many African countries started to revise their policy. In Tanzania and Egypt, for example, up to the late 1980s, students with completed secondary education were guaranteed entry into the civil service (see e.g. Assaad 1994). Today secondary school leavers can no more automatically expect the access to the civil service.

Unfortunately, only few African countries have sufficient data on wage structures over a long period of time to empirically analyze the trends in the returns to education (Schultz 1999, p. 77). However, with the fast increasing number of available household and labor force surveys, this might become an interesting issue of research in coming years.

Apart from looking at the overall effect of one more year of education, the effect can be differentiated with respect to different educational levels. The above discussion assumes that the effect is uniform across levels and identical for each additional year, but this seems to be, at best, a rather rough approximation. There could be higher returns, for instance, to the final year of each educational level, leading to the completion of a particular program (see e.g. Belman and Heywood 1991). But even more importantly, differences in returns could be expected with regard to the basic educational levels primary, secondary and tertiary education. Besides his review of studies on the Mincerian rate of return for one additional year of schooling, Psacharopoulos (1994) synthesizes the results of another 78 country studies distinguishing specific levels of education. In principle, it is possible to distinguish between different levels of education even in the simple Mincerian framework. In this case, dummy variables have to be introduced into equation (1) to allow the coefficient of schooling to vary between levels. However, the studies discussed by Psacharopoulos use a more complex and highly data consuming approach, leading to detailed age-earnings profiles by level of education (“elaborate method”). This approach has the advantage not to automatically equate the cost of an additional year of education with the annual earnings of a person with one year less of schooling. In low-income countries, where children often do not even complete primary school, the young age of school leavers makes it rather improbable that foregone earnings correspond to a full adult annual salary. In order to compare the rates of return at different levels of education involving different age groups of students, a corresponding distinction of foregone

earnings seems to be particularly relevant. The elaborate method deduces education benefits as well as education costs from a direct comparison with a control group of graduates of a lower level of education. The rate of return (r) is calculated as a discount rate equating the stream of benefits to the stream of costs at a given point of time (Psacharopoulos and Ng 1994, p. 188):

$$(3) \quad \sum_{t=s+1}^n \frac{w_b - w_a}{(1+r)^t} = \sum_{t=1}^s C_b (1+r)^t$$

The difference in earnings between a person with a higher level of educational attainment b and a lower level of educational attainment a is expressed by $w_b - w_a$. C_b are the annual cost during the s years of additional schooling, including both, direct cost and foregone earnings. The latter can be expressed in terms of w_a where appropriate, or omitted and / or replaced by lower values for younger age groups. The results for the African countries covered by Psacharopoulos (1994) and reported in Table 1 only cover those studies which do not assign foregone earnings to primary students aged 8 years and below.

Table 1: Private returns to education by level of attainment, Africa

Country (reference year)	Primary education	Secondary Education	Tertiary Education
Botswana (1983)	99.0	76.0	38.0
Côte d'Ivoire (1984)	25.7	30.7	25.1
Ethiopia (1972)	35.0	22.8	27.4
Ghana (1967)	24.5	17.0	37.0
Kenya (1980)		16.0	
Lesotho (1980)	15.5	26.7	36.5
Liberia (1983)	99.0	30.5	17.0
Malawi (1982)	15.7	16.8	46.6
Nigeria (1966)	30.0	14.0	34.0
Senegal (1985)	33.7	21.3	
Somalia (1983)	59.9	13.0	33.2
Sudan (1974)		13.0	15.0
Tunisia (1980)		13.0	27.0
Zambia (1983)			19.2
Zimbabwe (1987)	16.6	48.5	5.1
Country average	41.3	26.6	27.8

Source: Psacharopoulos (1994, Table A1, pp. 1340f.)

The table indicates considerable differences between the results of individual country studies. Overall, however, primary education yields by far the highest private returns. With the exceptions of Côte d'Ivoire, Lesotho, Malawi and Zimbabwe they dominate the returns of secondary education in all African countries for which this information is available. Tertiary education leads to higher returns than secondary education in all countries but Botswana, Côte d'Ivoire, Liberia and Zimbabwe. The overall patterns across educational levels are similar for other world regions: Primary education consistently shows the highest returns while tertiary education tends to slightly dominate returns to the secondary level (Psacharopoulos 1994, Table 1, p. 1328). In order to correctly interpret these results, it should be noted, however, that much of the differences of returns between levels is influenced by the differences in the opportunity costs of schooling discussed above, rather than by differences in the wage increments (Pritchett 1997, fn. 5, p. 6f.).

Besides looking at returns to education for all, one can compare the returns to education for different subsets of the population. In particular, it might be of interest to compare the returns for men and women. Psacharopoulos (1994, p.1329, Table 8) indicates that in his sample of countries all across the world, women's returns to schooling appear to be slightly higher than men's. The average rate of return is 11.3% for males and about 1.3 percentage points higher for females. Schultz (1996) estimates for Ghana and Côte d'Ivoire also don't generally show any substantial difference between both sexes. When a distinction is made between different levels of education, one exception appears, however: At the secondary level in Ghana, women's rate of return appears to be almost twice as high as men's. As compared to women in south and west Asia, it is much more common for women in Africa to work outside the family, in particular in agriculture and trading occupations. As compared to the women in those two other regions, they thus have an enhanced possibility to make use of their human capital on the labor market and to capture the corresponding returns (Schultz 1999, p. 79).

Another interesting disaggregation is by sector of employment, in particular, between the agricultural and other sectors of the economy. An early literature review by Jamison and Lau (1982) finds that, holding inputs constant, farming output increases by only 2% for each additional year of schooling. More recent studies on farming in Africa equally found only very low effects (see e.g. Gurgand 1997). It seems, however, that technological progress might increase the returns to schooling in agriculture due to the complementarity of human and physical capital. This could explain the particularly low rates of return to education for farmers in sub-Saharan Africa (Pritchett 1997, fn. 51, p. 49). Moreover, the estimates presented by Jamison and Lau might underestimate the

effect of education since they correct for a change in farming inputs. Education improves the ability to make informed decisions about new inputs both in terms of machinery and fertilizers. Education could therefore lead to higher returns precisely via the changes in inputs. This effect would bias the regression results.

Finally, it has to be noted that besides the quantity of education, the quality of education plays a significant role. Even if students spend the same time in school, the quality of the educational outcome can vary considerably. Learning conditions in many African countries are so bad, that pupils may leave school after several years of schooling without even reaching sustainable levels of basic literacy and numeracy. At the example of Ghana, Glewwe (1996, p. 277) shows that the reading and mathematics skills acquired in school are positively correlated with wages. The inclusion of these variables generally decreases the coefficient of the education quantity variable, but the latter also tends to remain positive and significant.

All in all, even though some questions remain open, the main results of the analysis of private returns to education in economic literature are clear and unambiguous: The private returns to education are substantial, and even more important in sub-Saharan Africa than in other regions of the world. Across different levels of education, returns to primary education generally appear to be the highest, because foregone earnings for smaller children are lower than for older ones. Returns for African women are at least as high as for men. And finally, private returns to education generally appear to be higher in the non-agricultural than in the agricultural sector.

Over the last decades, these findings have not changed in any significant way although more recent studies generally use more sophisticated econometric methods to correct for a possible sample selection bias (e.g. through the method introduced by Heckmann (1979)) and for the interdependence of education and other explaining variables (through instrumental variable methods).

2.2. Externalities and other indirect effects

Besides the direct effect of education on earnings, it can be observed that education influences other variables, which again have an impact on private income, either for the educated person him- or herself, or for other people in the person's neighborhood. Unfortunately, there is no generally accepted overall measure for this kind of effects comparable to the private rate of returns. The so called "social rate of returns" only adds public expenditure on education to the private cost

considered for the calculation of the private rate. The social rate of return thus relates individual returns to the total cost of education. Taking into account total cost instead of private cost alone reduces the overall rate of return. Moreover, since public expenditure per student tends to rise considerably with the level of education, social rates of return generally show an even clearer advantage of primary as compared to secondary and tertiary education.

Social rates of return are generally used to provide some indication of the efficiency of educational expenditure. However, the social dimension is included only on the cost- and not on the benefit-side. Positive externalities are not taken into account in the social rate of return (see e.g. Timmermann and Graff 1995, p. 345). The concept of social returns thus does not allow us to provide information in this respect.

Even though there is no agreed overall measure in analogy with the private rate of returns discussed in the previous section, there is abundant evidence on specific externalities and indirect effects. These indirect links are particularly well documented concerning externalities within the family where education of the parents, in particular of mothers, was consistently shown to be a significant factor improving children's health and education. According to Cochrane, Leslie and O'Hara (1980) and Schultz (1981) one additional year of schooling for mothers in low-income countries can be associated with a 5-10% reduction in the likelihood that their children die before reaching the age of five. These figures are roughly consistent with the recent results from Demographic and Health Surveys (DHS) for sub-Saharan Africa reported by Pritchett (1997, p. 42). Other studies reporting a positive effect of mother's schooling on her children's health in developing countries include Glewwe (1999), Schultz (1993), Hobcraft (1993), and Thomas, Strauss and Henriques (1991). Besides the effect on children's health, many authors also report an effect of education on fertility (see e.g. Wolfe and Behrman 1984, Schultz 1989, Behrman 1990). All in all, there is abundant evidence that education leads to more informed decisions with respect to health and hygiene, and to a reduced number of childbirth.

Just as education itself, health is a relevant component of each individual's human capital. A healthy and well-nourished worker will be absent from work less often and will be more productive while at work. It is therefore not surprising, that these factors influence private earnings, just as education does. In his econometric analysis of returns to human capital in Côte d'Ivoire and Ghana, Schultz (1996) distinguishes between the different forms of human capital. Besides the years of education, he uses the variables adult height and weight-to-height-squared (Body Mass Index) to

measure the impact of child nutrition and adult health and nutrition respectively. Both variables, the latter more clearly than the former, tend to be significantly and positively associated with private earnings, for both women and men. Strauss and Thomas (1998) present an extensive overview over the literature analyzing the effects of health and nutrition on productivity and income. They emphasize that the link is strongest at very low levels of health and high levels of malnutrition as prevalent in many low-income developing countries. Moreover, in developing countries, work is based to a great extent on physical strength and endurance, which also suggests a particularly high importance of good health (Strauss and Thomas 1998, p. 767 and 813).

In precisely the same way health and nutrition are influencing productivity at work, they can be expected to influence students' productivity at school. At the example of five sub-Saharan African countries, Michaelowa (2000, pp. 24f.) shows that children's undernutrition tends to have a negative influence on their performance in school. Other authors obtain the same result for other regions of the world (see e.g. Harbinson and Hanushek 1992 for Brazil, Jamison 1986 for China, Mook and Leslie 1986 for Nepal, and Martorell and Habicht 1986). Underperformance again, leads to earlier dropout, which is reflected in lower educational attainment. Comparing data from DHS on young children's undernutrition (see Morrisson, Guilmeau and Linskens 2000, Table 4, p. 18) with students' nutrition at grade 5, Michaelowa (2000, pp. 38f.) indicates that African countries vary considerably in the extent they manage to retain these children in school. Madagascar is shown to be a particularly problematic case with an extremely high dropout rate of this group of pupils.

The interlinkage of health and education is thus clearly established in the literature. Education of parents, and of mothers in particular, leads to better health and nutrition for their children, and this in turn influences the children's educational achievement and attainment - thereby enhancing the next generation's earnings prospects on the labor market.

Just as much as there are positive externalities of parents' schooling on their children's health, there are also positive externalities of parents' schooling on their children's education. The literature showing this effect is equally abundant since parents' education proved to be a relevant control variable for any regression of students' educational attainment and achievement for developed and developing countries alike. A few examples for Africa are Glewwe and Jacoby (1994) for Ghana, Tansel (1997) for Ghana and Côte d'Ivoire, and Michaelowa (2000) for Burkina Faso, Cameroon, Côte d'Ivoire, Madagascar and Senegal. Coefficient estimates in the latter study indicate that, *ceteris paribus*, test performance of fifth graders in math and French increases by between 4.5 and

7.5% of average scores when both parents are literate as compared to the situation when both parents are illiterate. As opposed to the influence of education on children's health, with respect to children's educational achievement, mother's education does not generally seem to have a more important impact than father's education does (see e.g. Tansel 1997, p. 826). In any case, educating themselves (future) parents rise the chances for their children's education as well, which in turn will increase their chances to find a relatively well paid job when they start working.

Besides the externalities of education on the educated person's own children, there can be positive externalities on other people in the neighborhood. For instance, if an educated farmer successfully tries out higher yielding crops or new production methods, other members of his village observing this might copy the innovations and thus also reach higher income. Foster and Rosenzweig (1995, pp. 1194f.) document this effect with evidence from India.

Moreover, there can be another microeconomic effect of education that does not necessarily correspond to higher individual earnings (although the probability seems to be quite high that it will do so, too). It will be mentioned here for completeness. This effect is the higher chance that a person participates in the labor market if he or she is educated. The effect can be observed in both developed and developing countries. It appears to be stronger for women than for men (OECD 2000a, pp. 260f. and Table E1.1 for OECD and eight Asian and Latin American countries; Mincer 1996). For Africa, data on labor force participation rates by educational attainment and gender are not available. For a few countries, however, it is possible to compare illiteracy rates of the population aged 15 years and over with the share of workers without schooling in the labor force. If education of persons in and outside the labor force was about the same, these shares should be approximately equal. Table 2 shows, however, that the share of uneducated persons is much higher in the population as a whole than in the labor force, in particular for Mauritius and Morocco.

Table 2: Education of the labor force versus education of the population, for selected African countries, 1995*

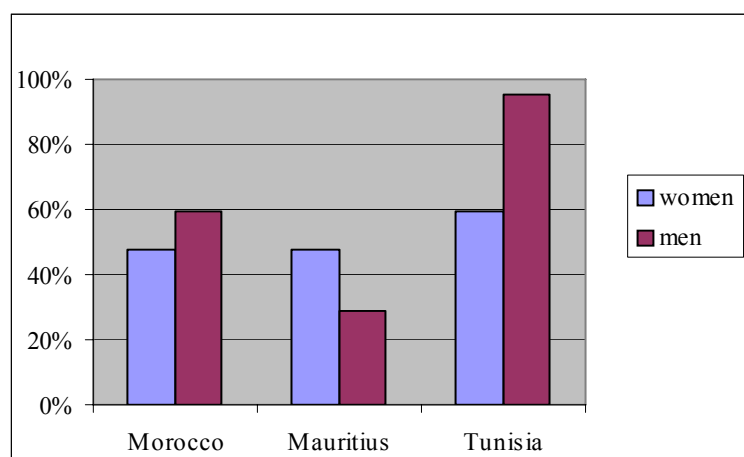
Country	All		Women		Men	
	% no schooling in labor force	% illiterate in population	% no schooling in labor force	% illiterate in population	% no schooling in labor force	% illiterate in population
Botswana	22.01	27.40				
Mauritius	6.06	17.80	10.46	21.90	3.91	13.70
Morocco	27.77	56.10	33.22	69.50	25.30	42.40
Tunisia	24.15	35.50	28.00	47.00	22.96	24.10

*Labor force data for Botswana are from 1996, for Tunisia from 1994.

Sources: ILO (1998) for labor force data, World Bank (1999) for illiteracy rates.

Among the three countries where a distinction by gender is possible, two show the usual pattern that differences are higher for women than for men. This is illustrated in Figure 3 which shows the relationship between the share of persons without schooling in the labor force, and illiteracy rates, expressed as the former divided by the latter. A ratio of 100% would indicate that the share of uneducated men or women is as high in the labor force as in the total adult population. A ratio below 100% indicates that their share is lower in the labor force. Overall, with the exception of men in Tunisia, the share of uneducated persons in the labor force is only 30-60% of the share of uneducated persons in the population as a whole. This indirectly confirms the observation for non-African countries, that participation in the labor force is positively related to education. Educated persons seem to have higher chances to participate in the labor force, and through the increased choice between work options, they may also invest their human capital more productively.

Figure 3: Ratio share of labor force without schooling to population illiteracy rate, by gender



Source: Table 2.

All in all, the indirect effects and externalities of education are well documented in micro level analysis, and they point to the fact, that the overall positive impact of education is even greater than the direct private returns discussed in section 2.1. It should thus be expected that at the aggregate level, where the effect is measured for the whole population, the overall impact of education will come out very clearly, and even more strongly than at the individual level. In particular, if the different direct and indirect microeconomic effects find their reflection on the macro level, one would expect to find strong evidence for an important impact of education on growth.

3. Evidence at the macro level

3.1. *Expected links and empirical evidence*

According to Figure 1 in the introduction, the following links between the effects of education at the micro level and the macro level can be expected:

- The increased earnings of educated persons themselves as well as of those who indirectly learn from them can be interpreted as a reflection of productivity gains through education. If overall, the population reaches a higher educational attainment, economic productivity should be enhanced which in turn should lead to higher growth. Put differently, the wage differential reflects the higher (productive) value of human capital which, as an input factor in the national production function, contributes to an increased national output.
- Through its impact on health, education positively influences a second dimension of human capital with similar consequences for increased productivity and growth.
- Through its impact on reduced population growth, education for a greater part of the population leads to reduced birth rates. From a merely statistical point of view, this obviously has to be considered if national income and growth are considered on a per capita basis. But even a part from that, it is clear that the number of childbirths affects women's physical ability to work and their productivity. It is closely related to the effect of health mentioned above.
- Finally, if education induces more persons to participate in the labor force, increased education of the population as a whole will lead to a higher labor force participation rate that might be expected to correspond to a reallocation of the population towards economically more productive activities. This in turn should have an impact on growth.

Unfortunately the link between the micro and the macro level is not as straightforward as it might appear in the first place. Although few economists would object that education has an important impact on macroeconomic growth, empirical evidence is difficult to interpret. While microeconomic effects are clearly documented in the literature and relatively unambiguous, this is not the case for macroeconomic effects. A multitude of empirical studies was carried out to test the effect of human capital on growth. However, overall, these studies do not come to reliable results. Cross-country studies in the early and mid-1990s relating growth to proxies for the level of human capital such as educational finance, enrolment rates, or years of schooling (see e.g. Mankiw, Romer and Weil 1992, Levine and Renelt 1992, Barro 1991) generally found a positive effect, but in many cases this effect seemed to be greatly overestimated as compared to what one would expect on the basis of the microeconomic evidence (Topel 1999, Bils and Klenow 2000). In the more recent

literature, even the direction of the effect has become a matter of debate. Questioning the relevance of a theoretical approach relating growth rates to human capital levels, some authors preferred to regress growth rates on changes in human capital (e.g. Pritchett 1997). Others included time-series information and carried out panel data estimations (e.g. Islam 1995, Caselli, Esquivel and Lefort 1996, Barro 1996). Authors using these approaches frequently reported insignificant or even negative results, at least for subsets of the sample or under particular model specifications. Barro (1996, pp. 15ff.), for instance, continues to find a high growth impact of male secondary and tertiary schooling, while male primary and female schooling turns out to be insignificant. Barro and Sala-i-Martin (1995) report a negative effect of female education. Benhabib and Spiegel (1994) show positive and significant results when the model tested allows for a specification of human capital in levels, while results are insignificant (with negative point estimates) when the model specification requires a measure of human capital in first differences. The specifications in first differences used by Pritchett (1997) as well as the panel specifications in Islam (1995) and Caselli, Esquivel and Lefort (1996) lead to significant and negative coefficients.

These counterintuitive findings have recently induced some authors to elaborate further on the measures of human capital. Dessus (1999) attempts to correct for education quality and comes to some more satisfactory results. However, his proxies for education quality are based on inputs since more reliable data (such as the Hanushek, Kim (1995) data set on educational achievement) are only available for a single year and thus not usable in panel specifications. De la Fuente and Doménech (2000) reexamine the panel data sets on years of schooling provided by Barro and Lee (1996) and Nehru, Swanson and Dubey (1995). Comparing these data over time and with more recent data provided by the OECD (various issues) for its member countries, they find considerable measurement problems, in particular in the time series. They argue that these problems could be, at least in parts, responsible for the lack of clear evidence of the impact of education on growth in panel and first difference specifications. Using their improved data set and introducing time fixed effects, they reach much more intuitive results.

Although these approaches seem encouraging, up to date, macroeconomic empirical evidence is so unreliable that it would be misleading to quote any specific figures referring to estimates of the effect of education on growth. This is true for international evidence in general, not just for evidence on low-income countries. None of the above quoted studies has a particular emphasis on developing countries. For various reasons, it can be assumed, that the problems encountered to measure the true effect of education on growth in these studies, will be even greater when the

analysis is confined to Africa or other regions of the developing world. While some of the possible problems have already been mentioned in the above literature overview, the following section offers a more structured discussion of these issues.

3.2. Data problems, variable interlinkages and other stumble stones

There are various reasons why the micro level evidence is not reflected at the macro level, and why those who mathematically deduce macroeconomic results from microeconomic evidence generally come to clearer conclusions than supported by direct empirical evidence on the macro level. Two issues will be dealt with here: (1) The difficulties to correctly interpret the coefficient in the private wage equation with respect to productivity gains in education, and (2) the problems of data availability and quality.

3.2.1. The interpretation of the coefficient in the private wage equation

In the first place, equating private returns to education with the individual's productivity gains through education is an extreme oversimplification. While labor economists generally agree about the sign and the approximate size of the coefficient in private wage equations, there is considerably less clarity about what this coefficient actually means. At first, it has to be clarified that for measuring productivity gains, not the private rate of return to education, but the full difference in earnings due to education - without any reductions for the cost of education - has to be taken into account. The underlying idea is that factor prices are set in line with factor productivity so that the wage differential reflects the increased productivity of labor due to additional education, or, put otherwise, the increased value of human capital. Pritchett (1997, p. 5) for instance, defines the value of the stock of human capital as the discounted value of the wage increment due to education. The corresponding formula can easily be reformulated in terms of the Mincerian rate of return, i.e. the coefficient of the private wage equation. Recent studies of growth accounting are generally based on this type of approach (Gundlach, Rudman and Wößmann 2000, p. 8). Alternatively, in a production function framework without explicit consideration of human capital, the Mincerian rate of return can be introduced as a direct component of Total Factor Productivity (see the description of the dual approach to growth accounting in Barro 1998, p. 6).

The problem is that, in reality, the measured earnings increment does not necessarily reflect only the individual's gains in productivity. Higher educational attainment might at least partly reflect the individual's innate abilities or determination, which, at the same time, might be the reason for his or her higher income. Those more able a priori, generally also get more education (Psacharopoulos

1994, p. 1328). In the same way, a person's social background is clearly related to both, educational attainment and income. Coming from a wealthy and influential family, a child has high chances to both, go through many years of education, and, even if he or she does not learn much there, have a relatively high income later.

It is therefore very difficult, if not impossible, to find out to what extent higher earnings are due to a positive effect of education and to what extent they just reflect the individual's background variables (signaling effect). Timmermann and Graff (1995, p. 347) note that the predominance of the latter depends on factors like the rationing of the labor market, hidden unemployment and the dominance of employment in the public sector, and that it may be particularly strong in poor countries with traditional systems. During the 1990s some authors have attempted to clarify the relative importance of signaling through the use of natural experiments. Ashenfelter and Krueger (1994) for instance, analyze a sample of identical twins whose background variables are obviously identical. However, if employers interpret different educational attainments as a sign of higher ability, it is not actual ability but the employers' perception that really matters. They will offer higher wages to the more highly educated person even if actual ability is the same. Therefore, results of the natural experiments are not really conclusive with respect to judging the signaling or screening effect (Temple 2000, p. 13). For differing opinions on the importance of the signaling effect see Weiss (1995) on the one hand, and Quiggin (1999) on the other hand. For an overall review of the relevant literature see Card (1999).

While signaling could lead to an overestimation of productivity gains through education, other effects rather tend to provoke an underestimation. Temple (2000, p. 24) argues that social returns might not be appropriately captured in traditional earnings functions. The externalities of education mentioned in section 2.2. imply an increased productivity of children and neighbors which is obviously not taken into account in the individual's private wage equation. Moreover, if an attempt is made to control for the influence of other dimensions of human capital, there is a risk that the influence of education will be biased downwards since it can assert its influence partly via these other channels artificially held constant. The problem to accurately separate out the effects of the different dimensions of human capital appears in a similar way on the micro and on the macro level. Barro (1996, pp. 16f.) for instance argues, that the insignificant effect he finds for women's education on growth might be related to the fact that he corrects for fertility. Since there is a strong negative correlation between women's education, especially at the primary level, and fertility, the positive effect of female education may be reflected by the coefficient of the latter. However, Barro

does not find much change in his results when he omits fertility from his growth equation. The sign of the coefficient for primary education turns from negative to positive, but remains insignificant.

Comparing the industrialized and developing countries with respect to the problem of interdependence of different dimensions of human capital, one might suspect that it should be stronger in the latter. The positive impact of education on health and reduced fertility is mainly found at the level of basic education. While an additional year of education in industrialized countries generally means an additional year at the upper secondary or tertiary level, it means an additional year of primary schooling in most low-income countries. The task to disentangle the different effects therefore seems to be even more difficult in a region like Africa than for OECD countries.

A further problem is related to the fact that the coefficients in the private wage equations highly depend on the national context: the supply of skilled labor, and private sector as well as public sector demand for human capital. The discussion in section 2.2 showed considerable differences between regions and even within the African region alone. Many of the macroeconomic growth regressions, however, assume that returns to human capital are constant across countries (Schultz 1999, p. 73).

Moreover, countries vary widely in the extent human capital can be expected to be used for productive activities. Private returns on education will greatly overestimate the impact of education on productivity in countries where people have a high incentive to rather invest their human capital into rent seeking and directly unproductive activities (Pritchett 1997, pp. 50ff.). Domestic and external trade policies in many African countries have been particularly favorable for this kind of economic behavior. Extreme expansion of public sector employment, payment structures rewarding social connections rather than skill, lack of accountability of civil servants, corruption at commercial courts leading to considerable difficulties in contract enforcement, extreme regulation of the private sector, and the reduction of competition through sealing off from foreign markets have been well known characteristics of most African countries during the last decades (Collier and Gunning 1999, pp. 10ff.). Graff (1999, pp. 8ff.) classifies countries according to different indicators of inequality and political repression, and shows that the effect of education on growth depends on these variables. Gelb, Knight and Sabot (1991) empirically show the detrimental effect of the absorption of “surplus” educated labor in the public sector. Thus in the context of a particularly

badly managed country, additional education, though privately profitable, can actually lead to a negative effect on growth.

There may be still other reasons why human capital is not always invested in productive activities: In Africa, more than on any other continent, international and civil wars have greatly impeded the productive use of human capital. Microeconomic studies on returns to education are generally not carried out in war torn countries for the simple reason of non-availability of the relevant micro data. The latter might lead to an upward bias of average returns to education for this region as a whole for reasons of geographical selection.

If these aspects are taken into account, it becomes less surprising to see a low, insignificant or even negative coefficient of education in a growth regression for the African continent, even though private returns to education have been shown to be particularly high. The above arguments suggest that the sign of the coefficient might be sensitive to an adequate combination of the human capital variable with policy variables such as corruption indices, public employment policy indicators, and dummies for war periods. While policy variables have frequently been introduced in growth regressions as separate explanatory variables (e.g. Collier 1999), they are generally not linked to the human capital variable as the above argument would suggest.

A further problem relating private returns measured at the micro level to macroeconomic growth can be the possible sample selection bias in microeconomic earnings studies (if not corrected for by econometric methods). While this effect is irrelevant for industrialized countries, it is highly relevant for low-income countries where only a relatively small share of the population participates in the labor force and receives money wages. In Ghana, for example, only 7% of women and 26% of men receive hourly wages, and in Côte d'Ivoire, the shares are 4% and 19% respectively (Schultz 1999, p. 78). Since taking part in the labor force is a choice that is itself dependent on education (see Table 2 in section 2.2.), studies restricting analysis to wage labor might well underestimate the impact of education. However, including self-employed and own-account workers and the economically non-active population, is equally problematic because it involves estimating non-wage and even non-monetary earnings, and because the different groups of income are difficult to compare.

All in all, one can say, that although there exists considerable unanimity concerning the positive private returns to education, it is not actually clear how this result has to be interpreted in terms of

productivity gains for the economy as a whole. On the one hand, the coefficient of education in the private wage equation tends to encompass much more than just productivity effects. On the other hand, not all relevant productivity effects are captured by the coefficient. Interpreted as an indicator of productivity, it could thus be either over- or underestimated, depending on the relative strength of either effect. Moreover, it is not always clear to what extent national calculations are based on a representative sample of the population or corrected for sample selection bias in an appropriate way. Though relevant for all regions of the world, it appears that all the problems discussed above have an even stronger impact in developing countries than anywhere else in the world.

3.2.2. Measurement and interpretation of the human capital variable in growth equations

Empirical analysis of endogenous growth has relied on differing model specifications. The most common specifications in the tradition of Romer (1990) imply that the initial stock of human capital positively influences growth via the development of ideas and inventions. Pritchett (1997, pp. 35f.) seriously questions the empirical analysis based on this type of models. His main argument is that if the positive effect of education was primarily related to spillover effects, this would be inconsistent with the strongly positive coefficient found in the micro level private wage equations. Moreover, he indicates that on purely econometrical grounds, the regression of growth rates on levels should lead to the problem of non-stationary residuals. He therefore proceeds with a regression of growth rates on change in educational attainment. However, he comes to rather unintuitive insignificant or even negative results, while earlier studies regressing growth rates on education levels more often find the expected significant and positive effect of education. In general, empirical evidence from cross-country regressions has been much more successful in finding a positive link between growth and the initial level of education than between growth and changes in education (Temple 2000, p. 24).

Temple (1999) argues, that the implausible results reported by Pritchett and others might be caused by outliers. When some of these are eliminated from the sample, the expected positive relation reappears. De la Fuente and Doménech (2000) find another, though possibly related explanation. They explain the problem of implausible regression results – in particular, when these regressions are carried out in first differences - with period specific shocks through unmeasured variables, and with measurement errors concerning educational variables. Plotting the shares of the population with primary, secondary and tertiary attainment according to Barro and Lee (1996) for each of 21 OECD countries over time, they find unexplainable sharp breaks and shifts in attainment levels. Moreover, in their comparison of educational attainment according to various data sources, they find that recent OECD data show secondary attainment rates which are more than twice as high as

those reported by Barro and Lee for six out of twenty countries, mainly because Barro and Lee apparently do not include apprenticeships and other vocational training programs. Germany is an extreme case since the share of vocational training programs in secondary education is very high. According to Barro and Lee, in 1990, only 32.4% of the population in West Germany completed at least lower secondary education (22% secondary + 10.4% tertiary, see De la Fuente and Doménech, Table 2, p. 9). This figure roughly corresponds to the 1997 OECD (2000b, Table 6, p. 153) figure for the younger age groups in India!

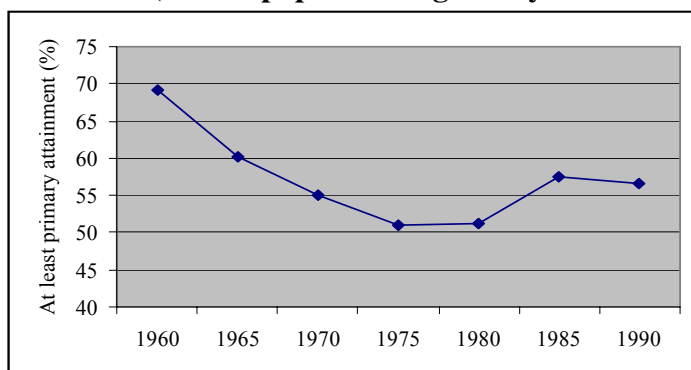
De la Fuente and Doménech (2000, pp. 5ff.) also compare the two most commonly used data sets for years of schooling from Barro and Lee (1996) and Nehru, Swanson and Dubey (1995). They show that while the coefficient of correlation of these data series is respectable for the whole sample of countries (0.81), it is far from convincing for the more homogenous group of OECD countries. This is true in particular at the primary and secondary levels where the coefficient of correlation is only 0.362 and 0.397 respectively. It can be assumed that the correlation for a homogenous set of low-income countries in sub-Saharan Africa would be equally low.

Generally, data problems and measurement errors are particularly strong in developing countries. It can therefore be expected, that the problems highlighted by De la Fuente and Doménech multiply when the focus is on developing countries. Indeed Table A1 in Annex 1 shows some surprising trends. Out of 25 African countries for which complete time series are available, 10 show at least one 5-year period where attainment rates decreased. This is surprising given that overall, enrolment increased so heavily throughout the last decades, and at least until the early 1980s. Moreover, there are considerable jumps in attainment rates. In the four countries Kenya, Senegal, South Africa and Swaziland the share of the population aged 15 years and over with at least primary attainment is reported to have risen by more than 15 percentage points within a single five-year period.² However, it is more difficult to interpret the available time-series for African countries than for OECD countries, because many of the former experienced considerable shifts in education policy so that even dramatic changes in attainment over a period of five years do not necessarily need to be impossible. Background knowledge about the development of national education policies over time, as well as about variables such as wars and civil wars which can heavily influence the size of the adult population (denominator) is necessary to judge each individual country case. Figure 4 shows

² The initial Barro-Lee data set from 1993 contains a considerable number of even more extreme cases, such as the rise of attainment levels (primary and above) in Botswana by 30 percentage points from 45.4% to 75.6% between 1980 and 1985. Data for these countries have been revised in the 1996 data set.

the example of Tanzania, a country whose education policy has been well documented over the years (see e.g. Lambert and Sahn 2000).

**Figure 4: Barro-Lee attainment rates for Tanzania
(for the population aged 15 years and over)**



Source: Barro and Lee (1996)

The data shown seem extremely implausible. Overall, between 1960 and 1990 attainment rates would have considerably decreased. They start from an extremely high level, higher than in any other African country and as high as in several European countries of that time. These initial figures from the 1960s seem to be greatly overestimated. They might reflect a non-weighted average of enrolment rates of different population groups in the 1950s, including Europeans. For the population as a whole, enrolment rates grew significantly during the 1950s, which should be reflected by an upward trend of attainment rates for the population aged 15 years and older during the 1960s. Thereafter, the positive trend slowed down, but restarted even more strongly in the 1970s (see UNESCO 1960, Central Statistical Bureau, various issues). Until the late 1970s Tanzania dramatically increased its enrolment capacity with the objective of reaching Universal Primary Education. According to the World Development Indicators (World Bank 1999), gross primary enrolment rates rose indeed from 34% in 1970 to 53% in 1975, and reached their peak of 99% in 1977. Afterwards, during the financial crisis, in particular between 1981 and 1988, enrolment rates decreased again down to a level of 69%. If a lag of five to ten years is considered for the enrolment rates to translate into adult attainment, the development of attainment rates from 1980 onwards seems to be reasonably well depicted in Graph 4. All in all, however, one is left with considerable doubt about the quality of the available attainment series.

Besides measurement error, there is the statistical problem of constructing relevant indicators. As already mentioned, education is only one aspect of human capital. The difficulties to distinguish

between the effects originating from schooling and those originating from improved health have already been discussed. Moreover, there is the aspect of work experience. Work experience is a factor regularly taken into account at the micro-level. Surprisingly, it is generally neglected in macroeconomic growth regressions. To reflect the different dimensions of human capital more fully, and also to be more consistent with microeconomic specifications, work experience should certainly be integrated more frequently into macro-level equations.

Moreover, even for the educational component of human capital alone, the choice of adequate indicators is a matter of discussion. It has been widely acknowledged in the recent literature that enrolment rates are only very poor indicators of the stock of human capital. They represent neither the stock of human capital, nor its change over time, at least during periods of rapid educational and demographic transition as experienced by many developing countries (Barro and Lee 1993, p. 366, Hanushek 2000, p. 2). This is why more recent studies concentrate on attainment data and average years of schooling at different levels of education. However, cross-country comparisons on the basis of these indicators are not unambiguous, as long as additional information on the structure of the school system and instruction time is not taken into account. The national concept of primary education, for instance, varies across countries between a formal duration of four years and a formal duration of ten years (UNESCO 1998, Table 3.1, pp. 3-7ff.). In Africa, the formal duration of primary schooling is lowest in Angola and Sao Tome and Principe (four years) and highest in Libya (9 years). Thus primary attainment corresponds to very different realities in different countries. Moreover the actual instruction time during one year in school varies considerably between countries. Among the 13 non-OECD countries covered by the corresponding indicator in OECD (2000b, Table 36, p. 169), annual hours of instruction for a nine-year old student vary between 455 hours in Uruguay and 1067 hours in the Philippines. This means that the average nine-year old primary student in the Philippines will receive the same amount of instruction within a single year as a student of the same age in Uruguay within 2.3 years.

Moreover, just as on the micro-level, it is obviously not education quantity alone that matters. Actually, the dimension of education quality (as opposed to quantity) seems to be even more important at the macro- than at the micro-level. While an individual might earn higher wages because more years of education signal higher competencies to the employer, at the aggregate level, additional years of education are worth nothing if these competencies are not really acquired. Pointing out the crucial importance of education quality for growth regressions, Hanushek and Kim (1995) construct a new data set based on educational achievement in mathematics and science as

measured by the International Association for the Evaluation of Educational Achievement (IEA) and the International Assessment of Educational Progress (IAEP). In their original analysis as well as in the more extensive testing for robustness by Hanushek and Kimko (2000), the coefficient of education quality appears to be consistently high, positive, and robust with respect to the introduction of additional variables. Its introduction into the regression considerably reduces the positive effect attributed to education quantity (Hanushek and Kimko 2000, p. 8).

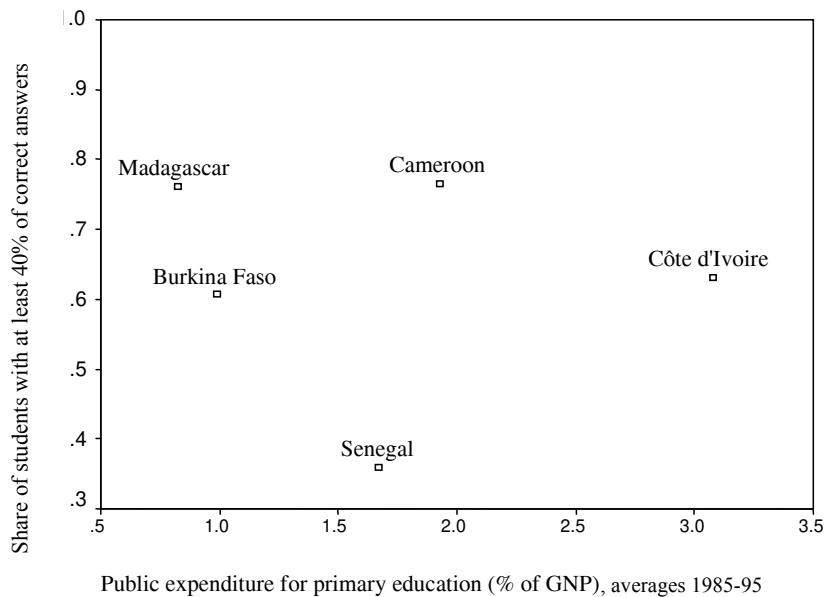
Unfortunately, low-income countries are only very badly represented in the data set. In Africa, original information through IEA or IAEP data is available only for two countries (Mozambique and Swaziland). The limited number of observations for low-income-low-attainment countries also restricts the possibility of estimating achievement values for these countries in order to include them into the authors' augmented data set. In their original estimation procedure, Hanushek and Kim (1995, p.28) sometimes even obtain negative achievement scores for these countries. Finally, all countries below the achievement level of the lowest performer are dropped from the sample. However, due to the thinness of observations at this end of the distribution, estimates for the remaining low-income countries in sub-Saharan Africa still remain of debatable quality.

A second problem of the achievement data set is, that it can only be used in model specifications using the level of human capital. There is only a single observation for each country, so that specifications in first differences or panel regressions are not possible.³ One might therefore be tempted to introduce variables such as public expenditure on education or student-teacher ratios as proxies for education quality (e.g. Barro 1991, Dessus 1999). Both indicators are, however, highly debatable, since they measure inputs rather than outputs.

Expenditure does not only relate to both, education quantity and quality simultaneously, it also varies considerably with respect to the effectiveness of its use. For five francophone African countries for which separate direct information on student achievement of fifth graders has been collected by the conference of their education ministries (CONFEMEN 1999), Figure 5 plots public expenditure on primary education against the share of students who reached a minimum of 40% of correct answers in standardized tests for the subjects French and mathematics.

³ For a number of OECD countries IEA and IAEP surveys were carried out repeatedly, so that for these countries, in principle, time series of student achievement could be constructed (see e.g. Barrow and Lee 1996 data set, schooling quality, Table 2). Hanushek and Kim, however, use a single measure combining the information for all years. In any case, for none of the few African countries covered in either data set, observations for more than one year are available.

Figure 5: Educational expenditure versus educational achievement



Source: Michaelowa (2000, p. 15)

No direct relationship between expenditure and achievement can be observed. While the efficiency of expenditure with respect to education quality seems to be relatively high in Madagascar, it is extremely low in Côte d'Ivoire and Senegal. Cameroon and Burkina Faso take intermediate positions. The missing direct link is confirmed by other studies (see e.g. Mingat and Suchaut 1998, pp.12ff.). Moreover, there is plenty of evidence on inefficient public spending on public services in Africa. According to the survey of primary education expenditure in Uganda by Ablo and Reinikka (1998) for instance, more than 70% of non-wage expenditure never even reached the schools.

Concerning class size or student-teacher ratios, the link to education quality is equally problematic. In his overview over more than 250 studies regressing education outcomes on student-teacher ratios (and other variables) Hanushek (1998, p. 21f.) comes, at best, to a very mixed result. It can be shown in the specific African context as well, that there is no clear evidence for a negative correlation between class size and education quality, even though factors like differences in equipment, urban or rural environment etc. are controlled for (Michaelowa 2000, p. 29). Curiously, while micro level studies at school and classroom level rather find a positive than a negative relationship between class size and achievement, macro studies tend to show the expected negative correlation. Hanushek (1998, p. 23) explains this effect with the problems of aggregation and the correlation of student-teacher ratios with other relevant policy variables at the state level which would make aggregate estimates rather unreliable. However, one could equally argue that possible endogeneity problems at the micro level – due to the fact that demand for enrolment will be higher

in good schools – might not be relevant for the cross-state or cross-country analysis, so that one should rather trust the macro level evidence. Some work still needs to be done to clarify this issue.

All in all, conceptional problems, restricted data availability and measurement errors cast considerable doubt on the reliability of growth regressions on human capital indicators, in particular concerning non-OECD low-income countries such as those of the African continent. In the future, efforts should be concentrated on the improvement of data on educational indicators. Some useful work is already under way. Increasingly, standardized school surveys on educational achievement also cover low-income developing countries. Besides PASEC, the program carried out under the responsibility of the CONFEMEN (1999) in francophone Africa, the Southern African Consortium for Monitoring Education Quality (SACMEQ, see Ross 1998) and the Laboratory Project of UNESCO-Santiago (1998) provide comparable data on student achievement for anglophone African and Latin-American countries respectively. Moreover, in a joint project financed by the World Bank, the OECD and the UNESCO are trying to bring about a considerable improvement of the reliability and cross-national comparability of conventional quantity and input based education indicators for about 20 developing countries (World Education Indicators, see OECD 2000b, ongoing project). A part from an improved collection of new data, a retrospective revision of data for the 90s is foreseen in the future to permit a trend analysis.

4. Conclusions

While private returns to education estimated in microeconomic studies give a clear indication of the positive impact of education for the individual, the interpretation of this result in terms of its overall economic relevance is ambiguous, and it remains difficult to provide clear evidence of the benefits of education at the aggregated level. While the theoretical relevance of human capital as a factor of production and a key to innovation and productivity gains is hardly questioned, empirical analysis fails to provide commonly agreed and reliable estimates of this effect. For developing countries such as, in particular, the low income countries of sub-Saharan Africa, it is even more difficult to give an indication of the impact of education on productivity and growth. There are good reasons to believe, for instance, that given the highly intransparent and inefficient political and economic systems of many of these countries, much of the private returns to education are achieved through non-productive activities. This means that in order to increase the relevance of education for economic growth, it would be necessary to undertake a restructuring of the political and economic framework. However, for the time being, the relevance of this kind of policy suggestions cannot be

deduced from empirical evidence, since macroeconomic estimates of the overall effect of education on growth are not sufficiently robust.

One major problem, for low-income countries even more than for others, is the incompleteness and inconsistency of current data sets for the stock of human capital. In particular, with respect to the important factor of education quality, comparable data on African and other low-income countries are extremely limited. As long as these problems persist, empirical studies at the aggregate level cannot be expected to come to generally agreed and consistent conclusions. And as long as even the most general results concerning the overall impact of education cannot be answered, this is even more the case for the more detailed policy relevant questions lying behind. So far, important questions, such as how to make the education system more efficient, which part of the system to support most, how to reduce possible political barriers to the productive use of human capital etc. are best analyzed at the micro level. At the current stage of empirical growth analysis, aggregate approaches do not offer any consistent insight concerning these issues.

Annex 1

Table A1: Share of population aged 15 and over with at least primary attainment, African countries (in %)

	1960	1965	1970	1975	1980	1985	1990
Algeria	20	18	26.2	33.5	42.4	50.4	57.7
Botswana	34.7	33.6	38.7	41.2	54.3	58.3	64.2
Cameroon	28.2	30.9	36.3	41	46	51.5	56.6
Central Afr. Republic	7.8	9.8	13.9	20	24.6	30	35.6
Ghana	20.5	22.9	35	38.9	43.3	47.1	49
Kenya	29.5	31.7	35.6	38.7	55.2	61.6	65.2
Lesotho	66.8	65.7	66	70.7	69.8	69.1	69.7
Liberia	10.5	13.5	17.3	20.1	26.4	34	34.3
Malawi	36.4	38.8	37.5	50.2	48.1	50.4	49.7
Mali	5.8	6	7.9	9.1	10.9	12.3	12.7
Mauritius	60.6	63.7	73.8	73.6	83.2	84.8	84.2
Mozambique	14.5	18.3	19.9	21.9	26.9	28.6	32.2
Niger	6	5.7	6.4	9.8	11.1	13.1	15.9
Senegal	36.9	33.9	33	48.2	44.8	43.2	43.4
Sierra Leone	7.3	9.3	11.9	20.9	23	25.7	30.4
South Africa	54	55	60.1	61.4	60.9	80.4	78.4
Sudan	12.5	14.7	17.3	21	25.7	30.5	34
Swaziland	34.3	35.8	39.1	57.1	60.3	64.5	68.6
Tanzania	69.2	60.2	55.1	51	51.3	57.4	56.7
Togo	5.8	10.4	15.9	22.7	32.4	42.8	47.3
Tunisia	9	15.4	26.1	35.1	45.3	47.9	55.9
Uganda	25.1	27.8	36.5	35.2	35.1	35.9	39.9
Zaire	19.7	23.9	28.7	35.1	40.6	45.7	49.2
Zambia	45.8	46.1	46.7	53.2	62.3	66.9	71
Zimbabwe	47.6	52.4	59.1	58.7	58.3	60.4	68.5

Note: Figures provided here are calculated as the sum of primary, secondary and tertiary attainment rates.

Source: Barro and Lee (1996).

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